Running head: employee turnover (volatility) and labor productivity

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THE IMPACT OF TURNOVER AND ITS VOLATILITY ON LABOR PRODUCTIVITY: A FLEXIBLE NON-LINEAR APPROACH

1. Introduction

In the past decades, employee turnover research has thrived because turnover is considered to have a substantial impact on organizational performance. Some propose a negative linear relationship such that each additional employee exiting the organization, causes a depletion of human and social capital and disrupts the functioning of the organization (Hancock, Allen, Bosco, McDaniel & Pierce, 2013; Hausknecht, Trevor & Howard, 2009; Heavey, Holwerda & Hausknecht, 2013; Shaw, 2011). Others suggest non-linear relationships arguing that (1) some amount of turnover can benefit the organization (e.g., the infusion of new ideas, cutting in labor costs) or (2) that especially low levels of turnover weaken organizational performance because in this case, employees have developed highly firm-specific human capital which is harder to replace. While the former implies an inverted-u curve, the latter suggests an attenuated negative relationship. Empirical studies mainly test the linear negative relationship, a minority also investigates non-linear scenarios by adding quadratic terms to the regression analysis (Hausknecht & Trevor, 2011; Heavey et al., 2013; Park & Shaw, 2013). This however gives limited insight into the exact non-linear nature of the relationship which may be more complex and may not simply be captured by quadratic terms. Specifically, an integration of the attenuated negative relationship with the inverted-u relationship has been suggested (Shaw, 2011), implying a relationship that initially increases, reaches a peak and then continues in a negative but attenuated fashion. Therefore, a first aim of this study is to take a more flexible non-linear approach to further explore the turnover-performance relationship. We do so by using polynomial regression analyses, a technique that is able to map complex non-linear relationships.

Secondly, despite much theoretical and empirical research digging into the turnover-performance relationship, to date, the role of time in this relationship has been largely ignored (Hausknecht & Trevor, 2011). A few scholars have made first steps towards acknowledging its importance by focusing on the timing of separations within a time period. Turnover research generally focuses on time frames of six months to one year (Hausknecht & Holwerda, 2013). Accordingly, Siebert and Zubanov (2009) argued and found that the timing of a separation (early in a year or late) determines the strength of its impact on firm performance within that year. Similarly, Hausknecht and Holwerda (2013) propose that turnover especially harms firm performance when it happens all at once rather than dispersed within a time period. The second aim of this paper is to further unravel the time dynamics in turnover. We argue that, apart from within a certain time period, also across time periods, turnover can be subject to high variability. Empirical research measuring turnover across multiple time periods has shown correlations ranging from .08 to .61 (Koys, 2001; Morrow & McElroy, 2007; Terborg & Lee, 1984). Therefore, rather than looking at the temporal dynamics of turnover within a given time period, we aim to broaden the scope by theorizing and testing the impact of turnover volatility, i.e. the turbulence or (in)stability of turnover across time periods.

We draw from organizational routines theory to build our case. From this theory, we infer that firms develop organizational routines to protect the organization from productivity losses triggered by turnover (e.g., designing a newcomer manual or training for newcomers). Given their context

dependency, these routines are different for organizations facing low turnover than those facing a high amount (Becker, 2004). When turnover is relatively stable across years (i.e. low volatility), organizations are able to develop efficient organizational routines to deal with it. Yet, when the turnover rate frequently and strongly changes (i.e. high volatility), effective routines are hard to develop or are continuously disrupted causing productivity losses (Gersick & Hackman, 1990). From this point of view, it is not only the level of turnover, but also changes in its pattern across time that will have an impact on organizational performance.

To capture firm performance, we focus on labor productivity because turnover involves changes related to the labor pool of organizations. Accordingly, it has repeatedly been recognized and used as an appropriate measure of firm performance (e.g., Glebbeek & Bax, 2004; Shaw, Gupta & Delery, 2005; Siebert & Zubanov, 2009; Yanadori & Kato, 2007) because it is more directly influenced by turnover than, for example, financial performance (Heavey et al., 2013; Shaw, 2011). In addition, it measures performance in a relatively comparable manner across organizations in a wide range of industries.

This study adds to turnover research in two ways. Firstly, we dig deeper into the relationship between turnover and organizational performance, by exploring the non-linearity in a more sophisticated manner. This provides more insight into the complexity of the relationship. Secondly, by focusing on turnover volatility, this study is the first to take into account the (in)stability of turnover across time to predict firm performance. Moreover, we introduce a new theoretical lens to explore the role of time, i.e. organizational routines theory.

2. Literature review and hypotheses

2.1 Turnover and Firm Performance

The relationship between turnover and firm performance has been subject to several contrasting views. On the one hand, there are reasons to assume that less turnover is better such that turnover affects organizational performance in a negative linear fashion. This is explained by the direct and indirect costs associated with turnover and is grounded in several theoretical frameworks, such as human and social capital theory, the resource-based view of the firm and the organizational disruption framework. Firstly, human capital theory suggests that employees' firm-specific human capital acquired through their work experience and training within the firm is an important driver of organizational performance (Becker, 1975; Shaw, 2011; Yanadori & Kato, 2007). This is because firm-specific human capital is a resource that strongly contributes to the competitive advantage of the firm by being valuable, rare, inimitable and non-transferable (as specified by the resource-based view of the firm) (Barney, 1991; Lepak & Snell, 1999; Shaw, Park & Kim, 2013). Turnover can therefore harm performance as it (1) harms the competitive advantage of the firm through the loss of firm-specific human capital and (2) decreases the return organizations obtain from investments in this human capital (e.g., firm-specific training) (Dess & Shaw, 2001; Shaw, 2011; Shaw et al., 2013). In addition, replacing these leavers with employees possessing the same level of firm-specific human capital requires substantial investments in terms of money and time (e.g., for recruitment, selection, socialization and training).

Following a similar line of reasoning, turnover implies a potential loss of valuable social capital (i.e. capital and resources which are incorporated in social networks and relationships) built up by leavers (Hancock et al., 2013). For example, when a leaver has many and important social connections within and outside of the organization, the organization may lose a key member of its organizational network and incur performance losses (Dess & Shaw, 2001). Finally, the operational disruption framework can be used to argue that turnover has strong repercussions for organizational functioning. Turnover disrupts the organization's operations both directly (e.g., by increasing the odds of work undone, of unmet commitments, and missed opportunities due to a decrease in employees or replacement employees being less-experienced and knowledgeable) as indirectly (e.g., through the cost of and time spent on hiring, socializing and training a new employee) (Hausknecht et al., 2009; Heavey et al., 2013; Watrous, Huffman & Pritchard, 2006). In sum, due to the losses or operational disruptions associated with turnover, it is assumed to decrease organizational performance in a linear fashion.

On the other hand, several non-linear relationships have been suggested (for an extensive review, see Shaw, 2011). Firstly, rooted in human capital theory and the resource based view of the firm, a negatively attenuated relationship between turnover and performance has been proposed (Shaw, Duffy, Johnson & Lockhart, 2005; Shaw, 2011). In the case of low average turnover, employees have worked sufficiently long in organizations to accumulate strong firm-specific human capital (Yanadori & Kato, 2007). This provides the organizations with valuable, rare, inimitable and non-transferable human resources thus contributing to the competitive advantage of the firm (Shaw et al., 2013). As a result, if an employee exits the organization, the organization loses this human capital and will need to invest a substantial amount of money and/or time in a newcomer to achieve the same level of firm-specific human capital (and thus performance) as the leaver. In the case of high average turnover, however, the organization will have developed less strong firm-specific human capital because employees exit at a faster and higher rate. If one employee exits the firm, his or her human capital level – and thus performance – will therefore be rather quickly regained by a newcomer with relatively less investments required by the organization. Thus, the negative marginal impact of an additional employee leaving the firm declines as turnover increases resulting in an attenuated negative relationship between turnover and firm performance (Shaw et al., 2013).

Secondly, based on a cost-benefits perspective, the notion of an inverted u-shaped relationship was introduced decades ago (Abelson & Baysinger, 1984). The main point here is that some amount of turnover can benefit the organization in several ways. It can allow firms to cut in high labor costs, correct its demography in terms of age or qualifications, acquire new and external knowledge (thereby increasing the firm's innovation potential), limit the risk of organizational blindness and replace underperforming employees (Abelson & Baysinger, 1984; Shaw, 2011). Moreover, although less visible, the retention costs needed to reduce turnover (in extremis to zero), can be excessively high in terms of for example higher compensation and benefits, more training, promotions, transfers and staff inflexibility (Abelson & Baysinger, 1984). Thus, although reducing turnover cuts turnover costs, it can increase retention costs. This implies that the total cost of turnover is a combination of turnover and retention costs and the optimal rate of turnover for an organization minimizes the sum of both (Abelson & Baysinger, 1984; Glebbeek & Bax, 2004). As a result, the relationship between turnover and firm performance takes on an inverted u-shape.

Finally, a more complex non-linear relationship was suggested which integrates the attenuated negative relationship with the inverted-u relationship. This entails a relationship that initially increases, reaches a peak and then continues in a negative but attenuated fashion (Shaw et al., 2005; Shaw, 2011). Hence, this view captures the potential of turnover to benefit the organization at low levels and the disruptive nature of high levels of turnover. Yet, it takes into account that the higher the proportion of turnover becomes, the less additional harm it does for an organization.

Despite the different views on the shape of the relationship between turnover and firm performance, empirical research has predominantly focused on testing a negative linear relationship and identifying the boundary conditions under which such a relationship is found (for extensive reviews, see Shaw, 2011; Hausknecht & Trevor, 2011). Negative linear relationships were found between turnover and several indicators of organizational performance, such as sales, profits, productivity, costs, customer satisfaction and value added (e.g., Batt, 2002; Huselid, 1995; Kacmar, Andrews, Van Rooy, Steilberg & Cerrone, 2006; McElroy, Morrow & Rude, 2001; Morrow & McElroy, 2007; Sels, De Winne, Maes, Faems, Delmotte & Forrier, 2006; Yanadori & Kato, 2007). In addition, evidence suggests that relatively proximal measures of organizational performance (e.g., productivity and efficiency) are directly affected by turnover which in turn influence more distal indicators of organizational performance (e.g., profits and financial performance) (Morrow & McElroy, 2007; Shaw, 2011).

Some boundary conditions have however been identified. For example, Hausknecht et al. (2009) showed that particularly larger work units and units with a relatively high degree of newcomers found it more difficult to cope with turnover. They attribute this finding to higher inefficiencies and more coordinating and communicating issues due to the size of work units and a relatively unexperienced workforce. Next, turnover has a detrimental impact on organizational performance only when the organization has heavily invested in a (high commitment) HRM system (Arthur, 1994; Guthrie, 2001). In such a case, the HRM system creates strong firm-specific human capital among employees which has more detrimental repercussions for the organization's competitive advantage if employees leave (Guthrie, 2001; Shaw, 2011). Finally, Hausknecht and Holwerda (2013) have stressed the importance of turnover properties. They proposed that the same amount of turnover can have a substantially larger impact on human and social capital depletion and organizational disruption when all turnover occurs simultaneously, when it occurs across a large range of positions in the organization, when highly experienced employees leave, when the remaining employees are novice and when the human and social capital of replacement employees is lower than the employees leaving.

Only a minority of studies have explicitly tested both linear and non-linear scenarios. Some studies find no evidence of a curvilinear relationship between turnover and firm performance in samples such as multinational retail organizations (Simón, de Sivatte, Olmos & Shaw, 2013) and call centers (Batt & Colvin, 2011). Others found support for a negative but attenuated relationship between turnover and organizational performance (Shaw et al., 2005; Ton & Huckman, 2008). However, Shaw et al. (2013) found this to be contingent on HRM investments in a sample of US and Korean organizations. The attenuated relationship was only found when HRM investments are high (in the US sample) or was found to be stronger when HRM investments are high (in the Korean sample). This is because, in the case of high HRM investments, the turnover involves employees possessing

strong firm-specific human capital which entails a detrimental loss for the organization. Finally, some studies find evidence for an inverted U-shaped relationship, yet only in specific samples such as part-time employees of retail stores (Siebert & Zubanov, 2009), employees working in temporary job agencies (Glebbeek & Bax, 2004) and teachers (Meier & Hicklin, 2008).

The above-mentioned results concerning a non-linear relationship imply that concluding a negative linear relationship between turnover and firm performance, is not straightforwardly warranted. Research thus needs to tests both linear and non-linear relationships between turnover and organizational performance to determine the viability of each theoretical view on the shape of the relationship (Hancock et al., 2013; Hausknecht & Trevor, 2011). Moreover, to our knowledge, the more complex non-linear view integrating an inverted U-relationship with the attenuated negative relationship is yet to be tested (Shaw et al., 2011). The non-linear relationship is generally tested by adding a squared turnover term to analyses, which excludes the possibility of a more complex relationship. Hence, we want to further explore the complexity of the relationship between turnover and organizational performance. To do so, we formulate four competing hypotheses in line with the aforementioned different views on the relationship between turnover and labor productivity (figure 1). In contrast to previous research that has mainly tested the impact of turnover in one or a few limited industries (for rare exceptions, see Sels et al., 2006; Yanadori & Kato, 2007), we do so in an extensive and representative sample of industries to get a broader and more general view of the shape.

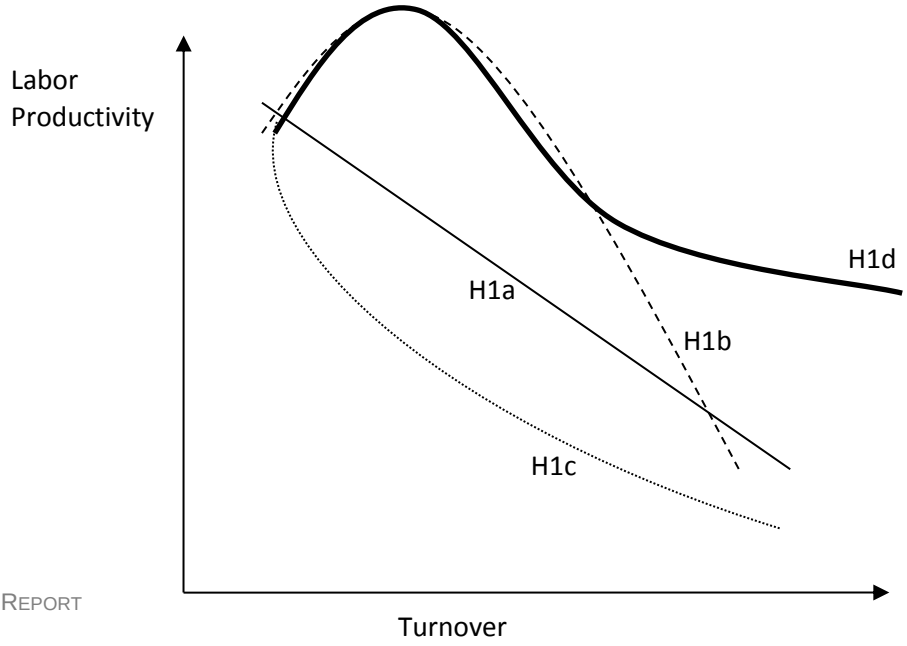
Hypothesis 1a: The relationship between turnover and labor productivity is linear and negative.

Hypothesis 1b. The relationship between turnover and labor productivity is inversely U-shaped

Hypothesis 1c. The relationship between turnover and labor productivity is negative but curvilinear (attenuated).

Hypothesis 1d. The relationship between turnover and labor productivity is inversely U-shaped for low to medium turnover and negatively attenuated for high turnover.

Figure 1. Visualization of Hypotheses 1a through 1d



2.2 Exploring the Role of Time: The Volatility of Turnover

To date, little research has acknowledged the important role time can play in the context of turnover (Hausknecht & Trevor, 2011). Traditional measures of turnover keep track of the number of separations and are therefore headcount-based (Hausknecht & Holwerda, 2013; Hausknecht & Trevor, 2011). The most commonly used measures are separation rates which are calculated by dividing the number of employees exiting the firm during a certain time period by the total number of employees (e.g., on average across the period) (Hausknecht & Holwerda, 2013). An alternative measure taking into account time was suggested by Siebert and Zubanov (2009) who measured turnover in terms of hours lost. In contrast to traditional headcount measures, this takes into account the difference between full- and part-time employees. The leave of full-time employees represents substantial more hours lost that need to be picked up by other employees or replacement employees in comparison to part-time employees. In addition, the timing of the separation within the focal time period is taken into account as the loss or termination of an employee in the beginning of a time period involves a greater amount of hours lost than it does at the end. As a result, the amount of hours lost by turnover manages to pick up the disruptive and depletive nature of turnover and was therefore found to strongly predict labor productivity (Siebert & Zubanov, 2009).

Similarly, Hausknecht and Holwerda (2013) suggested that the same amount of turnover can have a different impact depending on its timing. They proposed that when turnover happens all at once (i.e. low time dispersion) within a given time period (e.g., a year), firms will find it especially hard to cope as the average proficiency level of employees strongly declines at one particular point in time due to a high amount of newcomers. Thus, in this case, firms face heavy and simultaneous human and social capital depletion which takes a substantial amount of time, money and effort (e.g., towards recruiting, selecting, socializing and training newcomers) to overcome. In contrast, when turnover is evenly spread out over time, the organization's operations are less disrupted as – at any given point in time – the remaining employees are relatively proficient which can buffer the loss created by turnover.

The above suggests that turnover can strongly vary within a given time window which can affect organizational functioning. Turnover research generally focuses on time windows from six months to one year (Hausknecht & Holwerda, 2013). However, based on the limited amount of research measuring turnover across multiple time periods, it becomes clear that turnover rates can also strongly vary across time periods (correlations between time periods range between .08 and .61) (Koys, 2001; Morrow & McElroy, 2007; Terborg & Lee, 1984). We propose that this *volatility* across time can also influence the degree to which organizations are able to deal with turnover. We build on organizational routines theory to build our case which states that organizations develop routines to effectively cope with recurring events such as turnover. The concept of routines itself is subject to many definitions and conceptualizations but all definitions have in common that routines refer to *"repeated patterns of behavior bound by rules and customs*" (Edmondson, Bohmer & Pisano, 2001: 686). These patterns of behavior are a set of interactions between organization members that are triggered by a certain situation, task or problem that needs to be handled (Becker, 2004; Gersick & Hackman, 1990). Routines are functional to the organization in several ways. They allow firms to quickly take action and maintain performance in the case of certain events, therefore saving time

and energy (Gersick & Hackman, 1990). In addition, they reduce uncertainty in the organization, store knowledge about which course of action to undertake and provide stability for the organization (Becker, 2004).

Applied to the context of turnover, the event of the exit of an employee can be seen as a trigger for the development and use of organizational routines. The separation causes inefficiency, and subsequently lower performance, if the organization is not ready to cope with it. Consequently, the organization considers an exit as a negative experience, and tries to develop procedures and activities to cope with it and preserve performance in the future. Examples of such routines are (1) the design of a procedure regarding how and to whom work should be delegated after the exit of one employee, e.g. through the use of an employee skills inventory or cross-training; (2) the introduction of a newcomer manual or training activities to make sure that the knowledge transfer towards a newcomer is facilitated, he or she quickly becomes productive and the inefficiency following the leave of an employee is reduced; (3) hiring excess employees such that turnover is covered by this excess and (4) efforts towards continuous recruitment, e.g. by building long-term relationships with hiring agencies, universities… to call upon when needed (Mowday, 1984). This shows that organizations can gradually develop a *turnover routine* and become more efficient and effective in the event of turnover.

Routines are typically firm-specific as they are tailored to the specific situation of the firm and therefore difficult to successfully transfer to another context (Becker, 2004; Mowday, 1984). So, firms that are confronted with high numbers of separations will develop other routines (e.g., focused on quickly attracting and training newcomers) than firms confronted with low numbers (e.g., focused on dispersing knowledge in the firm to make sure that if one individual exits, one of the remaining employees can quickly replace him or her to buy the necessary time to find worthy replacement). As long as the circumstances (i.e. the turnover rate) remain stable across years, the development of these routines is functional for the organization by coordinating the course of actions that need to be undertaken. In this case, organizations are able to develop and perfection functional organizational routines. In contrast, when the turnover rate faces heavy peaks and lows across different years (i.e. high volatility), the organization will face problems to cope with it and organizational routines will become dysfunctional (Gersick & Hackman, 1990). In this case, the routines developed in the past to deal with turnover will be disrupted and inefficient because of a mismatch between the current routine and the organizational conditions (Edmondson et al., 2001). For example, firms with generally low turnover may focus primarily on cross-training employees so that the occasional leave can quickly be covered by another employee freeing the time to find a suitable replacement while preserving firm performance, e.g. in terms of labor productivity. If such a firm suddenly faces large numbers of separations in a certain year, this approach becomes unfeasible as the remaining employees are not able to compensate for the productivity loss. This strongly disrupts the organization's functioning, thus leading to declines in labor productivity and the necessity to quickly attract new employees to overcome this. Quickly attracting new employees however requires other routines for which the organization may not be prepared, such as building long-term relationships with hiring agencies or building an excess recruitment or labor pool to quickly call upon when needed. Conversely, firms with generally high turnover might predominantly focus on creating slack by hiring excess employees to compensate for separations or at least building

an excess recruitment pool which the firm can easily call upon (Mowday, 1984). If such a firm is confronted with a low separation rate in a certain year, this approach will be highly inefficient, for example because the organization employs an oversized workforce for the work that needs to be done, or because it has diverted away time, money and attention to creating an excess recruitment pool which does not need to be called upon. Both lower the labor productivity of the firm.

This illustrates that if the environment or conditions in which the organization operates changes (in this case: if the turnover rate strongly changes), the organizational routines to cope with these changed conditions should also change to preserve organizational performance (Becker, 2004; Brauer & Laamanen, 2014; Gersick & Hackman, 1990). However, routines are typically characterized by path dependence and stability (Becker, 2004). While empirical research has repeatedly shown that routines can change over time (for an overview, see Becker, 2004; Pentland, Hærem & Hillison, 2011), their evolution is often incremental involving relatively small changes to perfection them or tailor them to small changes in the environment (Becker, 2004). As a result, routines evolve in a path dependent way. This may not be sufficient when a large change in the environment occurs (e.g. an unexpected strong change in the level of employee turnover). This will require a more radical change or the redesign of organizational routines (Brauer & Laamanen, 2014; Gersick & Hackman, 1990). Especially when these changes are strong and frequent (i.e. high volatility in employee turnover), incremental changes in organizational routines may not suffice to uphold productivity in the organization (Gersick & Hackman, 1990). However, it takes time and effort to sufficiently change routines which additionally explains why firm performance is harmed in the process (Becker, 2004; Brauer & Laamanen, 2014; Edmondson et al., 2001). As a result, if the turnover rate is subject to frequent changes across different years, the frequent and strong changes required in the organizational routines will make the firm ineffective rather than effective. In such an environment, it will be difficult to develop stable and functional routines to deal with turnover as the environment – and thus the routines required to counter productivity losses incurred by turnover – changes (Gersick & Hackman, 1990). In sum, firms facing heavy turbulence in their turnover pattern from one year to another (*high volatility*) will be less able to protect themselves from labor productivity losses than firms with stable turnover patterns (*low volatility)*, irrespective of their level of turnover. Based upon this reasoning, we hypothesize that:

Hypothesis 2. The relationship between the volatility of turnover and labor productivity is negative, irrespective of the level of turnover.

METHODS

3. Data

The data are obtained from the Belfirst database (BvDEP, 2010). This database contains balance sheet and income statement data for all Belgian firms that are required to file their annual accounts to the National Bank of Belgium. In addition to the standard balance sheet and income statement data, all firms that employ personnel are required to file a social balance sheet, containing

information on the number of employees as well as on the in- and outflow of workers. The outflow of workers is of particular relevance to this study and represents the organization's turnover.

The sample used in the empirical analysis includes data for the years 1999 to 2008. We include firms from all sectors of activity, except for the sector 'Employment activities', since it includes firms that employ workers on a daily and weekly basis and is hence characterized by unusually high turnover rates. Moreover, for several reasons, we focused on firms that employed at least 50 employees in at least one year. First, most firms employing less than 50 employees are not required to provide detailed information on the outflow of workers[1]. Second, we expect larger firms to be less prone to measurement errors as they are more likely to systematically and accurately keep track of turnover. Moreover, as the denominator of the turnover rate is smaller for small firms, measurement error in the number of outflows creates larger variation in the turnover rate for these firms.

To verify the reliability of our data, we check whether the total number of employees at the end of a particular year is equal to the total number at the end of the previous year plus the inflow of new people, minus the outflow of employees. A substantial difference between both indicates that the organization did not accurately report the in- and outflow of employees. We decided to drop an observation from the data when the difference is larger than 10 percent of the total number of employees. As a result, 3% of the observations were dropped. Secondly, we clean for outliers to avoid their distortion of the results. We excluded all firm-year observations that are in the top five percentile of the distribution of the turnover rate, i.e. a turnover rate of 74% of the total number of employees in a given year and above). This results in a final sample of 45,044 firm-year observations for 6,246 firms. In a robustness check, we replicate our main results using a different and stricter cleaning procedure following a definition of outliers suggested by Tukey (1977). The results are not affected by the use of this different cleaning procedure (cf. appendix C).

3.1 Measures

Labor productivity. We calculated labor productivity as the gross value added divided by the average number of employees (part-time employees are given a weight according to the number of hours they work relative to a full-time employee). In all analyses, we use the natural logarithm of labor productivity to make the measure less sensitive to outliers. Moreover, to control for inflationary changes in labor productivity, we deflate value added using a NACE 2 digit value added deflator obtained from the EU Klems database (see appendix A for more details).

Turnover rate. Our measure includes the number of workers leaving the organization at their own initiative or due to the end of a fixed term contract. We divided this number in a given year, by the average number of employees in that same year. Turnover in the form of layoffs was excluded from the measure. The generally disruptive nature of employee turnover and its volatility that lies at the heart of the theoretical arguments mentioned above, applies less strongly to layoffs. Discharges are considered to benefit the organization, for example by replacing underperforming employees (McElroy et al., 2001; Park & Shaw, 2013). A recent meta-analysis also points towards a low disruptive nature of dismissals by finding no significant relationship between dismissals and firm performance (Park & Shaw, 2013). Therefore, we decided to drop them in the analyses.

Turnover volatility. Volatility is defined as the firm-level standard deviation of the turnover rate over all periods in which the firm was included in the sample and thus measures the within-firm turbulence in the turnover pattern throughout time. The higher the standard deviation, the more the firm faces peaks and lows across time and thus the higher turnover volatility. Note that by using the standard deviation, computed across all years that the firm remains in the sample, we implicitly assume that the firm faces a constant volatility over time and we use this to predict firm performance within the studied time window. In a robustness check, which we discuss further below, we relax this assumption and include the standard deviation computed over the previous three years, hereby creating a time varying measure of volatility.

Control variables. As control variables, we include firm-level capital intensity, age, size, and a set of sector and year dummies. Capital intensity is defined as the ratio of real tangible fixed assets over the average number of employees and is usually associated with higher labor productivity (e.g. van Ark, O'Mahony & Timmer, 2008). The age of the firm is calculated in years using the firm's year of incorporation. The size of the organization is captured by including the number of employees working in the organization in a given year. Size, age and capital intensity are expressed in natural logarithms to make the results less sensitive to outliers. Sector dummies are defined at the NACE[2] three-digit level and pick up sector level differences in labor productivity and turnover rates due to technological differences, variations in skill intensity of the labor force, etc. across different sectors. The year dummies control for cyclical changes in labor productivity and turnover rates.

3.2 Analytic Approach

Following the related literature (e.g., Glebbeek & Bax, 2004; Shaw et al, 2005), we apply hierarchical regression analyses to test our hypotheses. We first enter only the control variables in step 1, after which we include turnover in step 2. To test the non-linear nature of the relationship, we also perform polynomial regressions by sequentially adding the second and third order term of turnover in steps 3 and 4. For each consecutive regression, we verify whether the coefficients obtained are significant, allowing us to discriminate between Hypotheses 1a through 1d. In step 5, we additionally include the volatility of the turnover rate to test Hypothesis 2. All regressions are estimated using Ordinary Least Squares using robust standard errors. Thus, the equation is the following:

$$q_{it} - l_{it} = \gamma + \beta(k_{it} - l_{it}) + \delta l_{it} + \alpha v_i + f\left(\frac{S_{it}}{L_{it}}\right) + \tau D_t + \theta D_J + \eta_{it} \quad (1)$$

where $q_{it} - l_{it}$ is log labor productivity and $k_{it} - l_{it}$ is the natural logarithm of capital intensity. The coefficient on labor picks up the returns to scale as δ can be shown to be equal to $\alpha + \beta - 1$. The $f(.)$ function picks up how the turnover rate $\frac{S_{it}}{L_{it}}$ relates to firm level labor productivity while v_i represents firm level volatility in turnover. We also include a vector of sector dummies, D_J at the NACE 3 digit level to control for sector specific differences in labor productivity and turnover rates. Likewise the year dummies D_t pick up business cycle effects.

RESULTS

4. Summary Statistics

Table 1 displays the means, and standard deviations of the variables used in the estimation, as well as the correlations between these variables. The number of observations is 45,044. The average firm experiences a turnover rate of 16.6 percent although there exists substantial heterogeneity across firms as indicated by the high standard deviation (0.15). The average turnover rate is highest in the services sector (20 percent) and lowest in the manufacturing industry (12 percent). The volatility variable, measured as the standard deviation of the turnover rate within the firm (across all the years of observation for that firm) has a mean value of 0.08 and a standard deviation of 0.05, again reflecting substantial variation across firms. All variables except for the turnover rate and the volatility measure are expressed in natural logarithms to make the results less sensitive to outliers. The correlation coefficients show that the turnover rate is negatively correlated with labor productivity ($r = -.10$; $p < .001$). In addition, volatility is negatively associated with labor productivity ($r = -.04$; $p < .001$).

Table 1. Correlations and Descriptive Statistics

Variable	Mean	Standard Deviation	1	2	3	4	5
1. Turnover Rate	0.17	0.15	1				
2. Turnover Volatility	0.08	0.05	0.40***	1			
3. ln(Labor Productivity)	4.25	0.59	-0.10***	-0.04***	1		
4. ln(Employment)	4.62	0.95	-0.08***	-0.27***	-0.02***	1	
5. ln(Capital Intensity)	7.66	1.53	-0.05***	-0.03***	0.34***	0.02***	1
6. ln(Age of the firm)	3.07	0.79	-0.07***	-0.10***	-0.00	0.14***	0.06***

* $p < .05$
** $p < .01$
*** $p < .001$

5. Regression Analyses

The results of the hierarchical regression analyses are reported in table 2. In column 1, the results for the analysis with the control variables are reported. In column 2, we include the turnover rate and assume a linear relationship with labor productivity. The results show a negative relationship between turnover and labor productivity ($\beta = -.22$; $p < .001$): a one standard deviation (.15) increase in the turnover rate lowers labor productivity by 3.2%. The third column reports the results after including the squared turnover rate. This allows us to discriminate between hypotheses 1a, 1b and 1c. The results display a marginally significant negative coefficient on turnover ($\beta = -.13$; $p < .10$).

However, the coefficient on turnover squared is insignificant at all conventional significance levels. These findings seem to favor Hypothesis 1a over Hypotheses 1b and 1c, supporting a linear and negative relationship.

Table 2. Hierarchical Regression Analysis of Labor Productivity on Employee Turnover (Ordinary Least Squares)

	1	2	3	4	5
Turnover rate		-0.22*** [0.03]	-0.13 [0.07]	0.34* [0.14]	0.29* [0.14]
Turnover rate²			-0.17 [0.11]	-2.28*** [0.53]	-1.88*** [0.53]
Turnover rate³				2.31*** [0.53]	1.94*** [0.54]
Turnover volatility					-0.38*** [0.11]
Ln(Employment)	-0.02* [0.01]	-0.02* [0.01]	-0.02* [0.01]	-0.02* [0.01]	-0.02** [0.01]
Ln(Capital Intensity)	0.13*** [0.01]	0.13*** [0.01]	0.13*** [0.01]	0.13*** [0.01]	0.12*** [0.01]
Ln(Age)	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]
N	45044	45044	45044	45044	44784
R^2	0.32	0.32	0.32	0.32	0.32

Notes: All analyses include year and sector dummies. The robust standard errors, clustered at the firm level are mentioned between brackets.

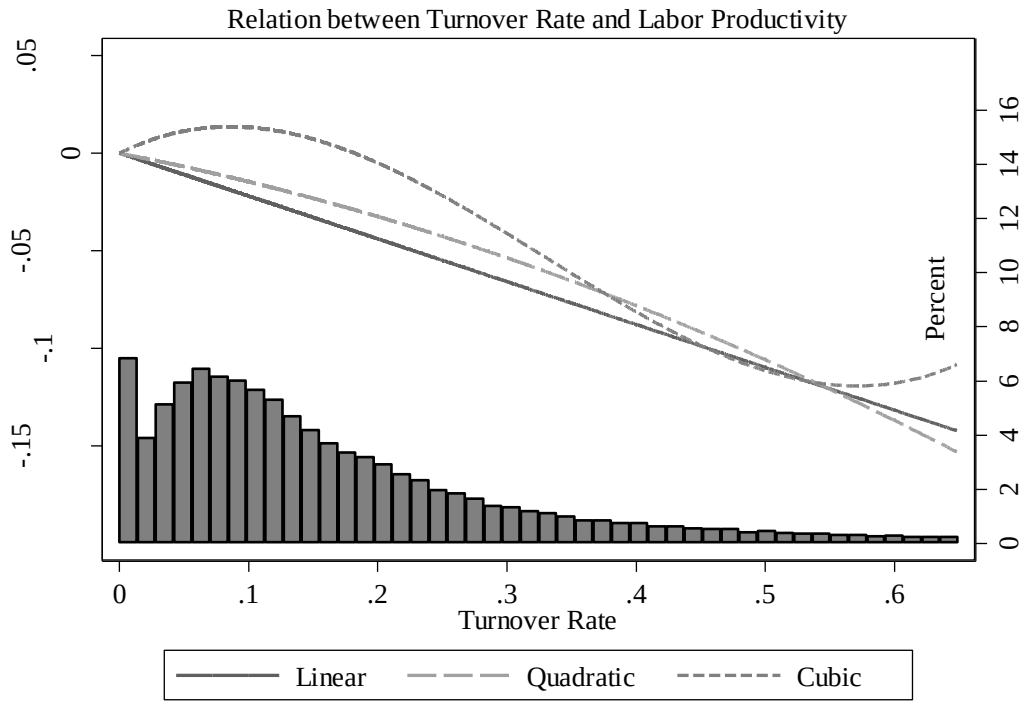
* p < .05

** p < .01

*** p < .001

However, allowing for a more flexible relationship between turnover and labor productivity, by adding the third power of the turnover rate (column 4 in table 2), changes the picture drastically. To ease the interpretation, we graphically represented the estimated link between turnover and labor productivity in figure 2. The figure also includes a histogram with the distribution of the turnover rate over all firms. The relationship is positive for low levels of turnover. As turnover rises, the *marginal* effect of turnover starts to decrease. The optimal turnover rate for the specification in column 4 of table 2 is 8.5 percent, which is below the average turnover rate reported in table 1. At turnover rates higher than this optimal rate, the marginal effect of turnover becomes negative, although the *total* effect on productivity is still positive: only firms experiencing turnover rates larger than 18.2% have lower labor productivity compared to firms with zero turnover. At high rates, the negative marginal effect of the turnover rate attenuates and the marginal impact of turnover becomes close to zero. All in all, the results strongly support hypothesis 1d, namely an inversely U-shaped relationship between turnover and labor productivity for low and medium turnover rates, and an attenuated negative effect for high turnover rates.

Figure 2. Relationship between Turnover Rate and Labor Productivity



Finally, in column 5 of table 2, turnover volatility is included. The reported coefficient for turnover volatility is negative and significant ($\beta = -.38$; $p < .01$): an increase by one standard deviation of turnover volatility (0.05) lowers labor productivity by 2.1 percent. This points to a negative impact of volatility on labor productivity. Hence, the results reported lend support to hypothesis 2.

6. Robustness Checks

We performed several robustness checks. As highlighted in earlier work (e.g., Glebbeek & Bax, 2004; Koys, 2001; Shaw et al., 2005), reverse causality and simultaneity problems are possible. For example, employees might be less likely to quit more productive firms, which offer a higher degree of job security and better working conditions. This problem is exacerbated by the fact that we measure firm's performance and its turnover at the same point in time. To control for this we follow two approaches. First, we exploit the longitudinal character of our dataset and control for the simultaneity problem by regressing labor productivity on *lagged values* of the turnover rate. We therefore replicate the specifications reported in table 2 and figure 2, but now each time for the turnover rate lagged one period. Results are reported in table 3 (column 1 to 3) and figure 3 (the upper graph). The conclusions drawn from the reported coefficients are qualitatively and quantitatively the same compared to the base specification where we include the contemporaneous turnover rate. This makes us confident about the earlier results. Moreover, the findings indicate that the impact of turnover is not only immediately visible, but that it could also take some time before its impact diminishes.

A second approach involves using a recently developed methodology from the productivity literature, i.e. the Wooldridge (2009) correction (e.g. Olley & Pakes, 1996; Levinsohn & Petrin, 2003). We do so because it is possible that the first approach does not resolve the endogeneity issues completely, as past events can create anticipation effects which will in turn induce reverse causality bias in the estimation. For instance, if a firm experiences a negative productivity shock today, employees can anticipate that the firm will go bankrupt in the near future and will be more prone to leave the firm. Appendix B explains the Wooldridge correction in more detail. The results from applying this correction are reported in the fourth column of table 3 and in figure 3 (the lower graph). The coefficients for the turnover rate are jointly highly significant ($p < .001$) and point to the same conclusions as the base specification reported above.

Table 3. Robustness Checks: Lagged Turnover Rate, Wooldridge (2009) Estimator and Time Varying Volatility

	1	2	3	4	5
	Lagged turnover rate			*Wooldridge*	*Time varying volatility*
Turnover Rate	-0.20*** [0.03]	-0.14 [0.08]	0.26 [0.15]	0.31 [0.38][a]	0.33* [0.16]
Turnover Rate²		-0.12 [0.13]	-1.99*** [0.57]	-2.82 [1.69][a]	-2.42*** [0.64]
Turnover Rate³			2.11*** [0.60]	3.44 [1.93][a]	2.52*** [0.67]
Turnover Volatility				-0.35*** [0.11]	-0.15* [0.06]
Ln(Employment)	-0.00 [0.01]	-0.00 [0.01]	-0.01 [0.01]	-0.21*** [0.01]	-0.01 [0.01]
Ln(Capital Intensity)	0.12*** [0.01]	0.12*** [0.01]	0.12*** [0.01]	0.05*** [0.01]	0.12*** [0.01]
Ln(Age)	0.00 [0.01]	0.00 [0.01]	0.00 [0.01]	0.01 [0.01]	0.00 [0.01]
N	37435	37435	37435	37224	32714
R^2	0.34	0.34	0.34		0.33

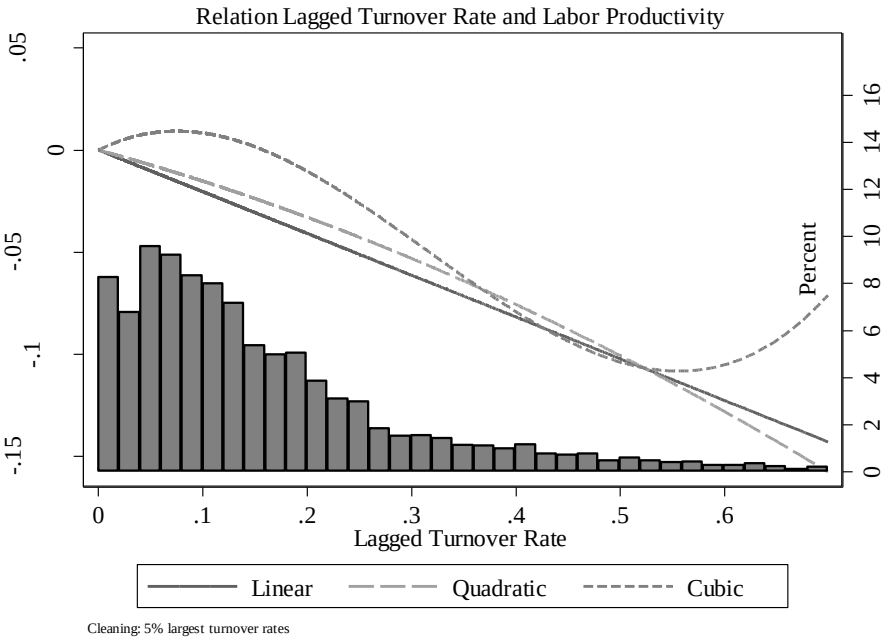
Notes: All analyses include year and sector dummies. The robust standard errors, clustered at the firm level are mentioned between brackets.

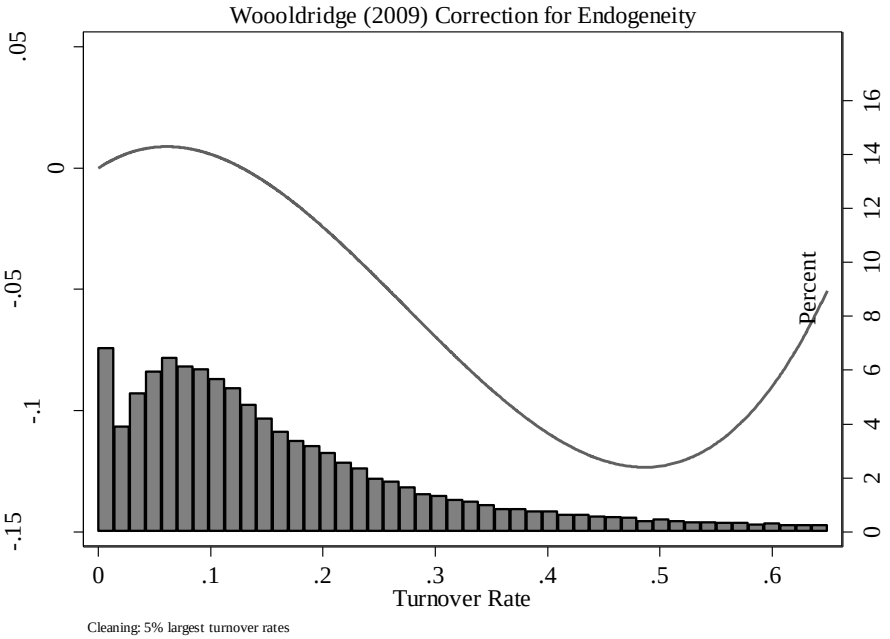
[a] While these coefficients are only marginally significant ($p < .10$), jointly, they are highly significant ($p < .001$) in explaining labor productivity

* $p < .05$

*** $p < .001$

Figure 3. Robustness Checks





As a final robustness check, we defined our measure for volatility as the standard deviation of the volatility rate computed from the previous three yearly observations. The advantage is that, in this case, the volatility is time varying. Moreover, future turnover rates are no longer used for the computation of volatility and the prediction of labor productivity. The disadvantage is that this measure is a less efficient estimate to capture an underlying constant volatility level (the correlation between these volatility measures is 0.67). The results are reported in the final column of Table 3. Again, we find the volatility of the turnover rate to be negatively related to labor productivity.

DISCUSSION

The main purpose of this study was to further increase the theoretical and empirical grasp on the relationship between turnover and firm performance, taking into account the potentially complex non-linearity of the relationship and the role of time. Concerning the nature of the relationship, we argued that the literature is characterized by different views on the shape of the relationship. We theoretically distinguished between the linear negative view and several non-linear relationships (i.e. an inverted U-shape, an attenuated negative relationship and an integration of both). To test and compare those views empirically, we made use of a flexible non-linear approach based on data from an extensive and representative sample of industries in Belgium. This allowed us to fully grasp the exact shape of the curve and draw conclusions on the viability of each theoretical view on the turnover-performance relationship. Our results seem to reject the hypothesis of a linear, inverted u-shape or negatively attenuated relationship. Instead, we found support for a shape combining the inverted u and negatively attenuated relationship such that for low levels of turnover, the marginal impact of the turnover rate on labor productivity is positive. As turnover increases, the marginal impact of tunover flattens off and becomes negative in an attenuated fashion.

These results have several important implications. They suggest that empirical research can benefit from testing more advanced flexible, non-linear patterns of the relationship between turnover and firm performance. Restricting the analyses to a linear and curvilinear relationship, would have led us to falsely conclude in favor of a linear relationship. Only by including higher-order terms, the true pattern is uncovered. This is mainly due to the finding that at intermediary levels of turnover – which covers the majority of observations – turnover is negatively related to performance. Yet, low levels of turnover show to be functional for an organization as opposed to zero turnover. Across all industries and organizations, we find an optimal turnover level of 8.5% and established a threshhold level of 18.2%, after which turnover becomes dysfunctional as opposed to zero turnover. In comparison, the few previous studies which established an inversely u-shaped curve found optimal levels ranging from 6.3% to 16.2% (Glebbeek & Bax, 2004; Meier & Hicklin, 2007; Siebert & Zubanov, 2009). This range can be attributed to the specific samples which were investigated such as retail stores, schools and temporary job agencies. In each organization or industry, the balance between retention and turnover costs might be different, leading to different optimal turnover levels (Glebbeek & Bax, 2004). Nonetheless, we offer additional empirical evidence for the existence of an optimal level of turnover and, more importantly, show that it is not restricted to specific samples of organizations or industries. On a theoretical level, these results call into question the ability of one single theoretical framework to capture the relationship between turnover and firm performance. Instead, they suggest that an integration of the different theoretical views on the relationship between turnover and performance is better able to predict the exact shape of the relationship.

Next, we also considered the role of time. The majority of turnover research has exclusively looked at the absolute level of turnover, thereby neglecting the potential role of time. We therefore extended prior research by focusing on the volatility of turnover rates across different time periods (i.e. years). To do so, we built on organizational routines theory. Our finding that the volatility of turnover rates affects labor productivity in a negative manner, is consistent with this theoretical framework. The lack of opportunities to develop stable and functional routines or the disruption of existing routines triggered by high turnover volatility can explain why labor productivity declines as

turnover volatility increases. These results have two important implications for turnover research. Firstly, they further confirm the importance of considering time aspects of turnover. This is in line with recent contributions in this field which stressed the importance of the timing of turnover and its dispersion within a certain time period (Hausknecht & Holwerda, 2013; Siebert & Zubanov, 2009). However, it extends these insights by drawing attention to the volatility or turbulence of the level of turnover *across* time periods. As such, we show that not only the level of turnover in the current time period affects organizational performance but also an organization's history of turnover. This supports the need for theory and research on turnover which transcends the typical focus of turnover research on one time period of six months to one year (Hausknecht & Holwerda, 2013). Herein lies the second implication of our study since we showed that organizational routines theory can offer such valuable insights. This theory assumes that organizational efficiency and productivity is in part dependent on the organization's ability to create functional routines to deal with recurring events such as turnover (Becker, 2004). A high degree of turnover volatility thwarts this process leading to productivity losses.

7. Limitations and Directions for Future Research

While studying an economy-wide sample allowed us to pronounce upon the general shape of the turnover – labor productivity relationship, an important first limitation of this study is that we did not look into the possibility that substantial differences can exist between industries. Firstly, the optimal level may differ as in different industries the balance between retention and turnover costs might be different (Glebbeek & Bax, 2004). In support of this, previous studies establishinig an inverse u-shaped curve found optimal levels ranging from 6.3% to 16.2% depending on the sample (Glebbeek & Bax, 2004; Meier & Hicklin, 2007; Siebert & Zubanov, 2009). Secondly, also the negative impact of moderate to high levels of turnover may differ across industries. Park and Shaw (2013) found a more detrimental effect of turnover in industries that rely heavily on human capital to obtain high performance (e.g., service industries) compared to industries relying less on human capital (e.g., manufacturing). Extrapoling this to our study, this could imply that the optimal level of employee turnover and the negatively attenuated impact of medium to high levels of turnover may vary significantly between industries. As such, we would encourage future research to look into non-linear relationships between turnover and organizational performance at the industry level to unravel potential significant differences.

Next, although the initial positive impact of turnover on labor productivity we found is theoretically grounded, this result conflicts with prior research that tested a curvilinear relationship between turnover and firm performance, yet did not find this positive impact (e.g., Shaw et al., 2005; Shaw et al., 2013; Ton & Huckman, 2008). The national context of the study, i.e. Belgium, could account for this as it may have driven the degree to which organizations can derive benefits from a limited amount of turnover. One such benefit is the avoidance of costly involuntary dismissals of poor performing employees (Abelson & Baysinger, 1984). Belgium has a particularly rigid labor market in which the cost of individual dimissals is relatively high. As a result, the voluntary leave of a poor performing employee can strongly benefit the organization by avoiding those costs. In more flexible labor markets where employees (can) more easily change jobs (e.g., the US; Cuñat & Melitz, 2012) these benefits may be lower resulting in attenuated negative relationships between turnover and performance (e.g., Shaw et al., 2005; Shaw et al., 2013; Ton & Huckman, 2009). This suggests that

the national context (e.g., the inflexibility of labour markets, law of governing dismissals) could play a substantial role in the relationship between turnover and firm performance. As such, we encourage future research to explore the turnover-performance relationship in a wide range of labor market contexts.

Third, next to industry and country, also the occupation in which the turnover occurs could matter a great deal. In Belgium, for a fair amount of occupations, there is a substantial shortage on the labor market due to high demands from organizations and/or supply shortages on the labor market (e.g., nurses, engineers, teachers…). As a result, if turnover is mainly situated in these professions, it will have a more profound negative impact on organizations as replacing such an employee is relatively hard and time-consuming. As such, in these cases, the positive impact of low turnover could be called into question and the negative impact of high turnover will probably be even stronger. In sum, important to discern in future research is under which conditions the general shape we found, holds and to which degree.

Finally, since we were unable to directly observe the (disruption of) organizational routines due to turnover volatility in this study, future research can benefit from studying this more closely. We know little about which routines organizations develop when faced with turnover, which actors are involved in these routines and how and to what degree these routines develop or change over time. The latter issue is crucial since the degree to which organizations can cope with frequent and strong changes in the level of their turnover, will depend on the flexibility and adaptability of their routines. To a large extent, this will be influenced by the level of consciousness among the actors involved in these routines. If routines have become so habitual that actors trigger the same existing routines for every employee exiting the organization without considering the appropriateness of those routines or alternatives, organizational routines become highly inert (Gersick & Hackman, 1990). Cognitive effort is required to question, adapt or recreate exiting routines (Becker, 2004; Brauer & Laamanen, 2014). Brauer and Laamanen (2014) suggest that this cognitive effort is more likely to be present when actors have the necessary time and resources to adapt or recreate routines. The degree to which the turnover volatility pattern is predictable will matter in this regard. If turnover fluctuates heavily but the organization is able to foresee this (e.g. based on historical patterns of turnover), actors involved in the routines have the necessary time to pro-actively engage in (re-)creating a set of routines both dealing with high and low turnover and to trigger the appropriate routines (Brauer & Laamanen, 2014). Hence, future research on the impact of turnover volatility could benefit from looking into the circumstances under which volatility harms organizational performance or not.

8. Practical Implications

Research on the relationship between turnover and organizational performance has practical significance as it helps organizations to gain insight in the consequences of turnover and whether they can benefit from reducing it. Our results show that low levels of turnover can benefit the organization in terms of labor productivity. This implies that organizations should not aim to fully eliminate turnover as this creates unnecessary high costs (e.g., retention costs) and significantly reduces the chances of obtaining benefits from turnover (e.g., the infusion of new ideas, avoiding dismissal costs). Instead, they should aim towards obtaining a low amount of stable turnover to optimally profit from these benefits. Organizations should thus look for strategies that reduce (but

not eliminate) turnover and keep the level of turnover stable across time. This will allow them to develop stable and functional organizational routines to deal with turnover without incurring losses in terms of labor productivity.

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FOOTNOTES

[1] There are a number of criteria that determine which firms have to file full or abbreviated accounts, one of which is the number of employees. Firstly, all firms with over 100 employees have to file a full account. Secondly, if the firm has exceeded more than one of the following ceilings over the last two financial years, the firm has to file a full account: (1) 50 employees, (2) 7,300,000 euro revenue and (3) 3,650,000 euro balance sheet total. The criteria can be found on the website of the National Bank of Belgium (www.nbb.be; 17/04/2011).

[2] NACE is the standard sector classification used in the European Union. Up until the 3-digit level, its structure is comparable to that of the International Standard Industry Classification (ISIC).

APPENDIX A: DEFLATORS

To obtain real values of value added and tangible fixed assets (capital), we rely on price indices obtained from two different sources. For value added, we use price deflators obtained from the EU KLEMS database. Producer price indices are available for all two-digit sectors of the Belgian economy between 1970 and 2007. Sectors in the EU KLEMS database are classified as NACE Rev. 1.1 sectors. However, the NACE classification was revised in 2008 and firms in Belfirst 2010 are classified according to NACE Rev. 2. Hence, to obtain a price deflator for the NACE Rev. 2 codes used in Belfirst, we use a concordance table from Eurostat (Ramon server) to translate NACE Rev. 1.1 codes into NACE Rev. 2 codes. To obtain price indices for 2008, which are not available in the EU KLEMS database, we apply the growth rates of the available indices between 2006 and 2007. An economy-wide price index for capital is obtained from Eurostat.

APPENDIX B: WOOLDRIDGE CORRECTION FOR ENDOGENEITY

Recall the estimation equation introduced in the main text:

$$q_{it} - l_{it} = \gamma + \beta(k_{it} - l_{it}) + \delta l_{it} + \alpha v_i + f\left(\frac{S_{it}}{L_{it}}\right) + \omega_{it} + \varepsilon_{it} \qquad (1)$$

The error term of this equation consists of productivity shocks, ω_{it} which are unobserved to the econometrician but taken into account when the firm chooses its optimal value of capital and labor, and ε_{it} which is not considered to influence firm choices. Moreover, the rate of employees exiting the firm, can very well be influenced by changes in unobserved productivity making the turnover rate endogenous. For example, an employee working for a firm performing badly – reflected in low values for ω_{it} – could be more likely to leave the firm compared to a worker employed in a highly productive firm. Consequently, OLS estimates for coefficients on the turnover rate are potentially biased. To control for this, we rely on recent developments in the literature on production function estimation. More precisely, we use the insight that optimal input demand holds information on productivity ω_{it} and can be used to control for it (Olley & Pakes, 1996; Levinsohn & Petrin, 2003; Wooldridge, 2009). We refer to these papers for a more thorough discussion of the methodology while we discuss the general idea here below.

The setting is as follows: each period, a firm chooses its optimal material input after observing its current productivity level ω_{it}. Consequently material demand by firm i in period t is a function of productivity and other state variables such as the capital stock. If material demand is monotonically increasing in productivity, the function can be inverted and productivity can be written as a function of materials and capital, $\omega_{it} = h(k_{it}, m_{it})$.

Next, we assume productivity to follow a first-order Markov process, namely productivity in period t is a function of productivity in the previous year plus a productivity shock ξ_{it} which was unforeseen in the previous period. As a result, ω_{it} can be written as a function of lagged capital and materials plus ξ_{it}:

$$q_{it} - l_{it} = \gamma + (\delta - \beta)l_{it} + \beta k_{it} + \alpha v_i + f\left(\frac{S_{it}}{L_{it}}\right) + g(k_{it-1}, m_{it-1}) + \xi_{it} + \varepsilon_{it} \quad (3)$$

We estimate equation (3) using Generalized Method of Moments. Appropriate instruments depend on assumptions concerning how freely adjustable inputs are. In line with other papers, we allow firms to adjust their labor stock to unforeseen productivity shocks. Consequently, we instrument labor with its lagged value. Moreover, we allow turnover to react to the productivity shocks as well and instrument the variables with their lagged values. Concerning the capital stock, we assume it takes some time before new capital goods are delivered and installed in the firm. As such, the capital stock is uncorrelated with unexpected shocks to productivity and contemporaneous capital stock can be instrumented by itself. We approximate the unknown $g()$ function with a 4th order polynomial in lagged capital and materials. Each element of the polynomial can serve as its own instrument.

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Olley, G. S. & Pakes, A. 1996. The dynamics of productivity in the telecommunications equipment industry. ***Econometrica***, 64(6): 1263-1297.

Wooldridge, J. M. 2009. On estimating firm-level production functions using proxy variables to control for unobservables. ***Economics Letters***, 104(3): 112-114.

APPENDIX C: TUKEY (1977) CLEANING

As a robustness check, we follow Tukey (1977) to define outliers. More precisely, we define U as $U = x_{75} + \frac{3}{2}(x_{75} - x_{25})$ where x_{75} and x_{25} are the 75th and 25th percentile of the turnover rate respectively. Subsequently, we drop observations for which the turnover rate is larger than U (0.53). Following a similar reasoning, a lower bound of the turnover rate can be defined but no observations fall below this lower bound. The results using this cleaning procedure are summarized in table C.1 and depicted in figure C.1 and result in the same conclusions as our original cleaning method.

Table C.1. Hierarchical Regressions Using the Tukey (1977) Cleaning Method

	1	2	3	4	5
Turnover rate		-0.23*** [0.04]	0.04 [0.10]	0.81*** [0.19]	0.75*** [0.19]
Turnover rate²			-0.62** [0.20]	-5.16*** [0.95]	-4.75*** [0.95]
Turnover rate³				6.66*** [1.31]	6.27*** [1.32]
Turnover Volatility					-0.41** [0.15]
Ln(Employment)	-0.01 [0.01]	-0.02 [0.01]	-0.02* [0.01]	-0.02* [0.01]	-0.02* [0.01]
Ln(Capital Intensity)	0.13*** [0.01]	0.13*** [0.01]	0.13*** [0.01]	0.13*** [0.01]	0.13*** [0.01]
Ln (Age)	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]
N	43366	43366	43366	43366	43057
R-sq	0.32	0.32	0.32	0.32	0.32

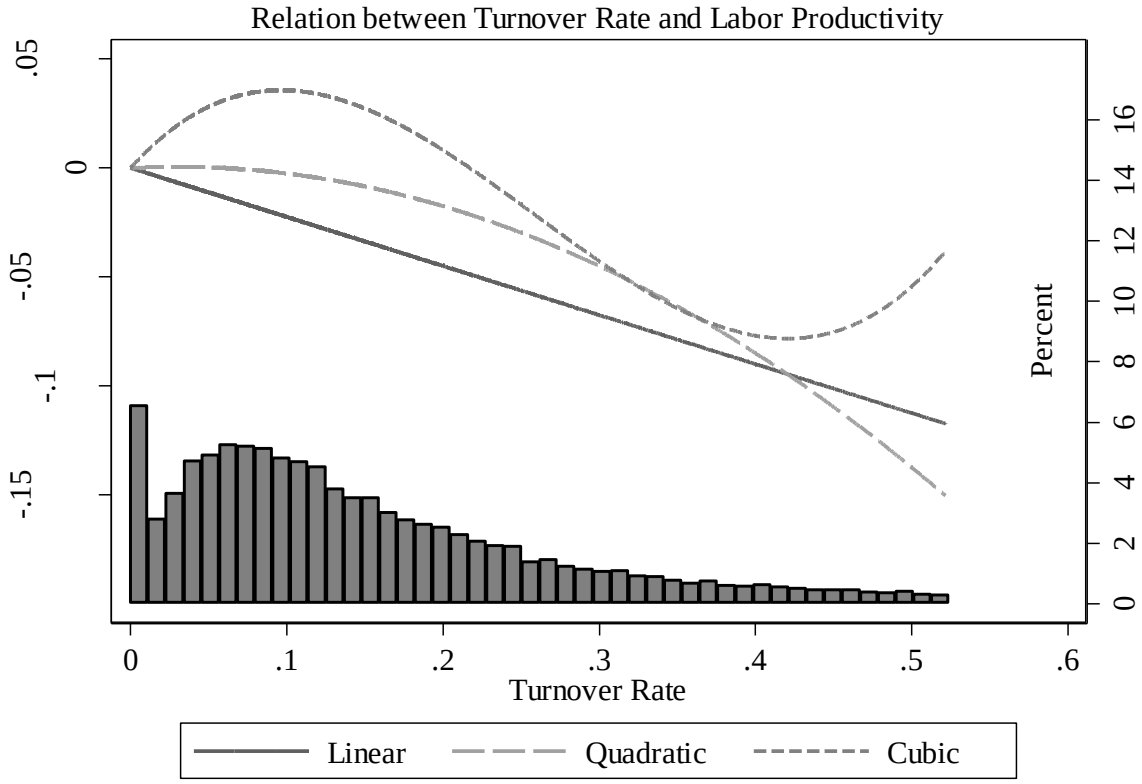
Notes: All analyses include year and sector dummies. The robust standard errors, clustered at the firm level are mentioned between brackets.

* p < .05

** p < .01

*** p < .001

Figure C. 1. Relation Between Turnover Rate and Labor Productivity (Tukey (1977) Cleaning)



Cleaning: Tukey (1977)